FB SERIES Full-Brick

Up to 600 Watt DC-DC Converter

PRODUCT OVERVIEW

The FB series offers up to 600 watts of output power in standard Full-Brick package. This series features high efficiency up to 92%, high power density and 1500 Volts of DC isolation. These converters are reliable, and compact with a single output voltage. The FB series can deliver up to 50A of output current and provide a precise regulated output voltage over a wide input range of 18-36 or 36-75 volts. These modules operate over a wide case temperature range of –40°C to +100°C. This series offers direct cooling of dissipative components for excellent thermal performance. The main features of these converters include remote On/Off (positive or negative), remote sense, output voltage adjustment, over voltage, over current and over temperature protection.

FEATURES

- Industry standard Full-Brick Package
- Up to 600 Watts of output power
- Regulated Output, Fixed Switching Frequency
- Up to 92 % Efficiency
- Fully Isolated to 1500 Volts
- Over Current Protection
- Inverter Operation Monitor function (I.O.G)
- Input Under/Over Voltage Lockout Protection
- Extended temperature range of -40°C to +100°C
- Isolated On/Off logic control
- Continuous Short Circuit Protection
- Safety meets EN55022 Class A specifications

APPLICATIONS:

- Distributed Power Architectures
- Telecommunication
- Data and Wireless communications
- Servers
- Military and industrial applications

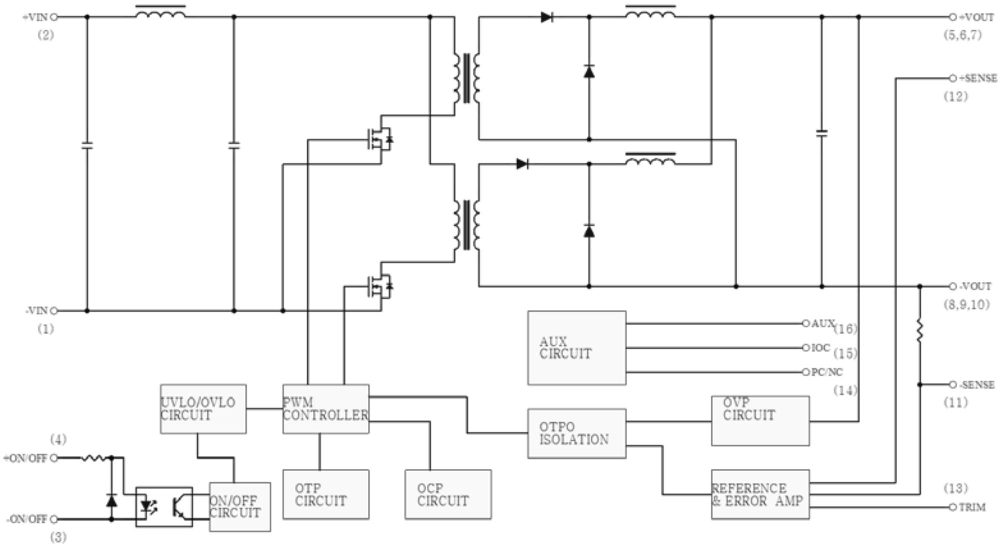
AVAILABLE OPTIONS

- Customizable Input/ Output voltages
- Heatsink, customizable packaging

Contact DATEL for other series of Full Brick footprint, Cost Saving, Lower Power, different output voltage, etc.

MODEL NUMBER	INPUT VOLTAGE	OUTPUT VOLTAGE	OUTPUT CURRENT MAX	EFFICIENCY %	LOAD REGULATION	OPTIONS
FB24S12-50	18-36 VDC	12 VDC	50A	88	±0.5	P, H
FB24S24-25	18-36 VDC	24 VDC	25 A	90	±0.5	P, H
FB24S28-21.5	18-36 VDC	28 VDC	21.5 A	90	±0.5	P, H
FB24S32-19	18-36 VDC	32 VDC	19 A	91	±0.5	P, H
FB24S48-12.5	18-36 VDC	48 VDC	12.5 A	91	±0.5	P, H
FB48S12-50	36-75VDC	12 VDC	50 A	90	±0.5	P, H
FB48S24-25	36-75VDC	24 VDC	25 A	92	±0.5	P, H
FB48S28-21.5	36-75VDC	28 VDC	21.5 A	91	±0.5	P, H
FB48S32-19	36-75VDC	32 VDC	19 A	92	±0.5	P, H
FB48S48-12.5	36-75VDC	48 VDC	12.5 A	92	±0.5	P, H

Block Diagram



ABSOLUTE MAXIMUM RATINGS

PARAMETER	CONDITIONS	MODEL	Min.	Typical	Max.	Units
Input Voltage						
Continuous	DC	$24V_{in}$ $48V_{in}$	-0.3 -0.3		36 75	Volts
Operating case Temperature		All	-40		+100	°C
Storage Temperature		All	-55		+105	°C
Input / Output Isolation Voltage	1 minute	All	1500			Volts

Note: Stresses above the absolute maximum ratings can cause permanent damage to the device. Exposure to absolute maximum ratings for extended periods can affect the device reliability.

INPUT CHARACTERISTICS

Note: All specifications are typical at nominal input, full load at 25°C unless otherwise noted

PARAMETER	CONDITIONS	MODEL	Min.	Typical	Max.	Units
Operating Input Voltage		$24V_{in}$ $48V_{in}$	18 36	24 48	36 75	Volts
Input Under Voltage Lockout						
Turn-On Voltage Threshold		$24V_{in}$ $48V_{in}$	16 34	17 35	18 36	Volts
Turn-Off Voltage Threshold		$24V_{in}$ $48V_{in}$	15 32	16 33	17 34	Volts
Lockout Hysteresis Voltage		$24V_{in}$ $48V_{in}$		1 2		Volts
Maximum Input Current	100% Load, V_{in}= 18V for FB24SXX	24Vin		37.7		A
	100% Load, V_{in} =36V for FB48SXX	48Vin		21.7		
No-Load Input Current	V_{in} =Nominal input	FB24S12-50 FB24S24-25 FB24S28-21.5 FB24S32-19 FB24S48-12.5 FB48S12-50 FB48S24-25 FB48S28-25 FB48S32-19 FB48S48-12.5		150 150 150 150 200 90 100 105 90 130		mA
Inrush Current (I^2t)	As per ETS300 132-2	All			0.1	A^2s

OUTPUT CHARACTERISTIC

PARAMETER	CONDITIONS	MODEL	Min.	Typical	Max.	Units
Output Voltage Set Point	V_{in} =Nominal V_{in} , I_o = I_{o_max}, Tc=25°C	Vo=12V Vo=24V Vo=28V Vo=32V Vo=48V	11.82 23.64 27.58 31.52 47.28	12.00 24.00 28.00 32.00 48.00	12.18 24.36 28.42 32.48 48.72	Volts
Output Voltage Regulation						
Load Regulation	I_o= I_{o_min} to I_{o_max}	All			±0.5	%
Line Regulation	V_{in}=low line to high line	All			±0.2	%
Temperature Coefficient	TC=-40°C to 100°C	All			±0.03	%/°C
Output Voltage Ripple and Noise						
Peak-to-Peak	20MHz bandwidth, Full load, 10μF tantalum and 1.0μF ceramic capacitors	Vo=12V Vo=24V Vo=28V Vo=32V Vo=48V			120 240 280 320 480	mV
RMS	5Hz to 20MHz bandwidth, Full load, 10uF solid tantalum and 1.0uF ceramic capacitors	Vo=12V Vo=24V Vo=28V Vo=32V Vo=48V			60 100 100 120 200	mV
Operating Output Current Range		FB24S28-21.5 FB48S28-25 Vo=12V Vo=24V Vo=32V Vo=48V	0		21.5 25 50 25 19 12.5	A
Output DC Current Limit Inception	Output Voltage=90% Nominal Output Voltage	All	110	125	150	%
Power Good Signal(IOG)	Vout ready: low level, sink current	All			20	mA
Power Good Signal(IOG)	Vout not ready: open drain output, applied voltage	All			50	V
Output Capacitance	Full load (resistive)	12V	470		10000	μF
Output Capacitance	Full load (resistive)	24,28,32,48V	470		5000	μF

DYNAMIC CHARACTERISTICS

PARAMETER	CONDITIONS	MODEL	Min.	Typical	Max.	Units
Output Voltage Current Transient						
Step Change in Output Current	d_i/d_t=0.1A/us, Load change from 75% to 100% to 75% of Io,max	All		±3	±5	%
Setting Time (within 1% Vout nominal)	d_i/d_t=0.1A/us	All			500	μs
Turn-On Delay and Rise Time						
Turn-On Delay Time, From On/Off Control	$V_{on/off}$ to 10%V_{o_set}	All			75	ms
Turn-On Delay Time, From Input	V_{in_min} to 10%V_{o_set}	All			250	ms
Output Voltage Rise Time	10%V_{o_set} to 90%V_{o_set}	All			50	ms

FEATURE CHARACTERISTICS

PARAMETER	CONDITIONS	Device	Min.	Typical	Max.	Units
100% Load **Efficiency**	V_{in} =24 V_{dc}, $I_o = I_{o\_max}$, Tc=25°C	FB24S12-50		88		%
		FB24S24-25		90		
		FB24S28-21.5		90		
		FB24S32-19		91		
		FB24D48-12.5		91		
	V_{in} =48 V_{dc}, $I_o = I_{o\_max}$, Tc=25°C	FB48S12-50		89		%
		FB48S24-25		91		
		FB48S28-25		92.5		
		FB48S32-19		91.5		
		FB48D48-12.5		92		
ISOLATION CHARACTERISTICS						
Isolation Voltage	1 minute; input/output, input/case, output/case input/remote, output/remote				1500	Volts
Isolation Resistance			10			MΩ
Isolation Capacitance				4000		pF
Switching Frequency		Vo=12,28,32V		300		KHz
		Vo=24,48V		250		
ON/OFF Control Negative Remote On/Off logic						
Logic Low (Module Off)			0		0.01	mA
Logic High (Module On)			1.0		10	mA
ON/OFF Control Positive Remote On/Off logic						
Logic High (Module Off)			1.0		10	mA
Logic High (Module On)			0		0.01	mA
Auxiliary Output Voltage		All	7	10	13	V
Auxiliary Output Current		All			20	mA
Load Share Accuracy (50%-100% load)			-10		+10	%
Off Converter Input Current	Shutdown input idle current				50	mA
Output Voltage Trim Range	P_{out}=max rated power		60		110	%
Output Over Voltage Protection			115	125	140	%
Over-Temperature Shutdown				110		°C
Over-Temperature Shutdown		All		110		°C
MTBF	I_o=100% of I_{o_max}: T_a=25°C per MIL-HDBK-217F			450		K hours
Weight				220		grams

Operating Temperature Range

The FB series converters can operate within a wide case temperature range of -40°C to +100°C. Consideration must be given to the de-rating curves when ascertaining maximum power that can be drawn from the converter. The maximum power drawn from the full brick models is influenced by many factors, such as:

- Input voltage range
- Output load current
- Forced air or natural convection

Output Voltage Adjustment

The output voltage on all models is adjustable within the range of 60% to 110%.

Over Current Protection

The converter is protected against over current or short circuit conditions. At the instance of current-limit inception, the module enters a constant current mode of operation. While the fault condition exists, the module will remain in this constant current mode, and can remain in this mode until the fault is cleared. The unit operates normally once the output current is reduced back into its specified range.

Output over Voltage Protection

The converter is protected against output over voltage conditions. When the output voltage is higher than the specified range, the module enters a hiccup mode of operation.

Remote On/Off

The Remote On/Off input pins permit the user to turn the power module on or off via a system signal from the primary side or the secondary side. Two Remote On/Off options are available. Negative logic turns the module on as long as a current (1-10mA) is flowing between +on/off and –on/off and inactive when no current is flowing. Positive logic turns the module off as long as a current (1-10mA) is flowing between +on/off and –on/off and active when no current is flowing.

Under/Over Voltage Lock Out (UVLO &OVLO)

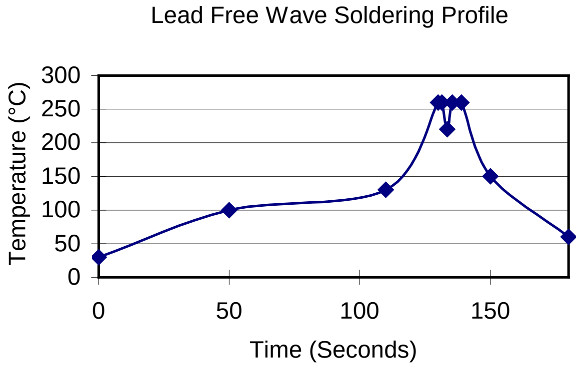
Input under/over voltage lockout is standard on this series of converters. At input voltages below/beyond the input under voltage lockout limit, the module operation is disabled.

Over Temperature Protection

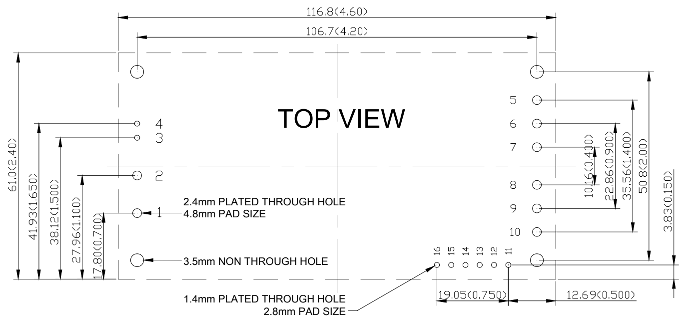
These modules have an over temperature protection circuit to safeguard against thermal damage. When the case temperature rises above over temperature shutdown threshold, the converter will shut down to protect it from overheating. The module will automatically restart after it cools down.

Recommended Layout, PCB Footprint and Soldering Information

The user must ensure that other components and metal in the vicinity of the converter meet the spacing requirements to which the system is approved. Low resistance and low inductance PCB layout should be used where possible. Proper attention must also be given to low impedance tracks between power module, input and output grounds. The recommended footprints and soldering profiles are shown in the next two figures.



Note：
1. Soldering Materials: Sn/Cu/Ni
2. Ramp up rate during preheat: 1.4 °C/Sec (From 50°C to 100°C)
3. Soaking temperature: 0.5 °C/Sec (From 100°C to 130°C), 60±20 seconds
4. Peak temperature: 260°C, above 250°C 3~6 Seconds
5. Ramp up rate during cooling:-10.0 °C/Sec (From 260°C to 150°C)



Recommend PCB Pad layout

Convection Requirements for Cooling

To predict the approximate cooling needed for the full brick module, refer to the power de-rating curves. These de-rating curves are approximations of the ambient temperatures and airflows required to keep the power module temperature below its maximum rating. Once the module is assembled in the actual system, the module's temperature should be monitored to ensure it does not exceed 100°C as being measured at the center of the top of the case (thus verifying proper cooling).

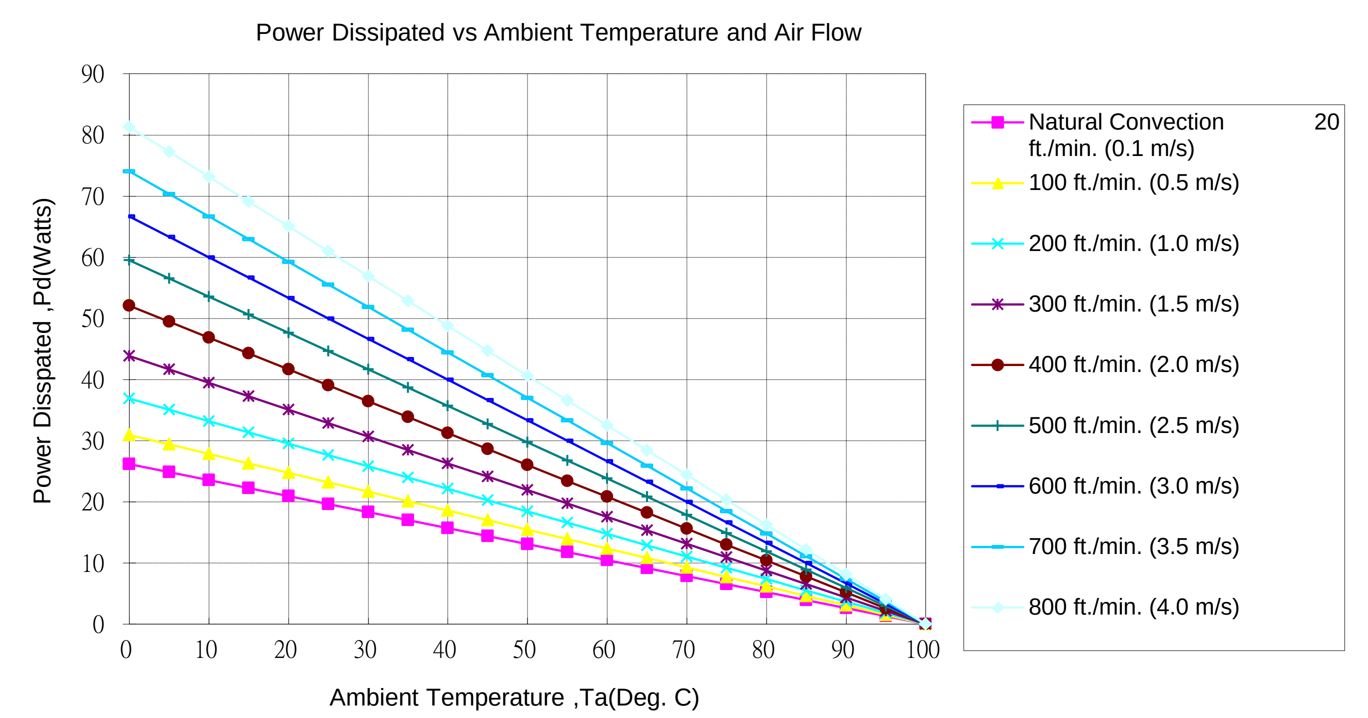
Thermal Considerations

The power module operates in a variety of thermal environments; however, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat is removed by conduction, convection, and radiation to the surrounding environment. The power output of the module should not be allowed to exceed rated power (V_{o_set} x I_{o_max}).

Power De-rating

The operating case temperature range of the FB series is -40°C to +100°C. When operating the FB series, proper de-rating or cooling is needed. The maximum case temperature under any operating condition should not be exceeded + 100°C.

The following curve is the de-rating curve of FB series without heat sink:



Example:

What is the minimum airflow necessary for a FB48S12-50 operating at nominal line, delivering an output current of 30A and a maximum ambient temperature of +40℃

Solution:
Given:

V_{in}=48V_{dc}, V_o=12V_{dc}, Io=30A

Determine Power dissipation (P_d):

Pd =Pi-Po=Po(1-η)/η

Pd =12×30×(1-0.9)/0.9=40Watts

Determine airflow:

Given: P_d =40W and Ta=40°C

Check above Power de-rating curve:

minimum airflow= 700 ft./min.

Verifying: The maximum temperature rise

△T = Pd × Rca=40×1.35=54°C

The maximum case temperature Tc=Ta+△T=94°C <100°C

Where:

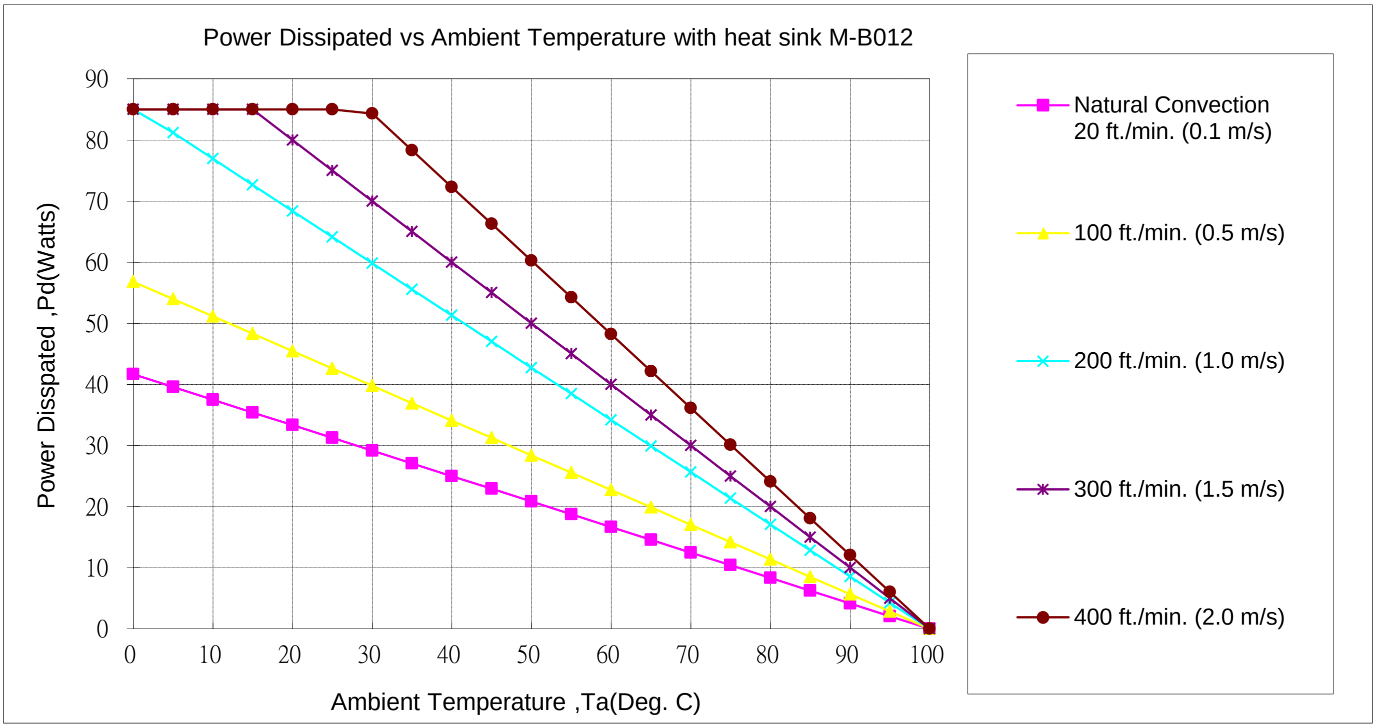
The R_{ca} is thermal resistance from case to ambience.

The Ta is ambient temperature and the Tc is case temperature.

Chart of Thermal Resistance vs Air Flow

AIR FLOW RATE	TYPICAL R_{ca}
Natural Convection 20ft./min. (0.1m/s)	3.82 °C/W
100 ft./min. (0.5m/s)	3.23 °C/W
200 ft./min. (1.0m/s)	2.71 °C/W
300 ft./min. (1.5m/s)	2.28 °C/W
400 ft./min. (2.0m/s)	1.92 °C/W
500 ft./min. (2.5m/s)	1.68 °C/W
600 ft./min. (3.0m/s)	1.50 °C/W
700 ft./min. (3.5m/s)	1.35 °C/W
800 ft./min. (4.0m/s)	1.23 °C/W

The following curve is the de-rating curve of FB series with heat sink M-B012:



Forced Convection Power De-rating with Heat Sink M-B012

AIR FLOW RATE	TYPICAL R_{ca}
Natural Convection 20ft./min. (0.1m/s)	2.4 ℃/W
100 ft./min. (0.5m/s)	1.76 ℃/W
200 ft./min. (1.0m/s)	1.17 ℃/W
300 ft./min. (1.5m/s)	1.00 ℃/W
400 ft./min. (2.0m/s)	0.83 ℃/W

Example:

What is the minimum airflow necessary for a FB48S12-50 operating at nominal line, an output current of 50A, and a maximum ambient temperature of 40℃

Solution:
Given:

V_{in}=48V_{dc}, Vo=12V_{dc}, Io=50A

Determine Power dissipation (P_d):

Pd=Pi-Po=Po(1-η)/η

Pd=12x50x(1-0.9)/0.9=66.7Watts (Chart of Thermal Resistance vs Air Flow)

Determine airflow:

Given: Pd=66.7W and Ta=40℃

Check above Power de-rating curve:

minimum airflow= 400 ft./min.

Verifying:

The maximum temperature rise △T= Pd × Rca=66.7×0.83=55.4℃

The maximum case temperature Tc=Ta+△T=95.4℃<100℃

Where:

The Rca is thermal resistance from case to ambience.

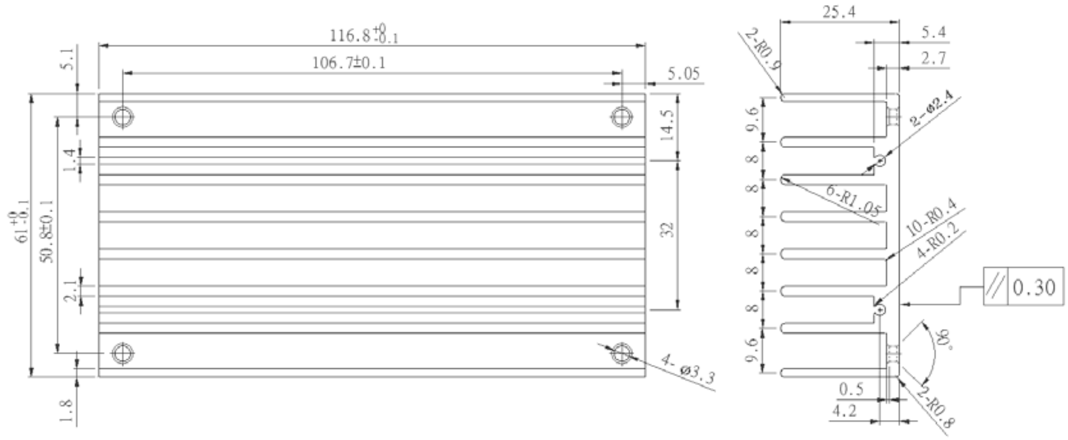
The Ta is ambient temperature and the Tc is case temperature.

Full Brick Heat Sinks:

Heat-sink M-B012

All Dimension In mm

Longitudinal Fins

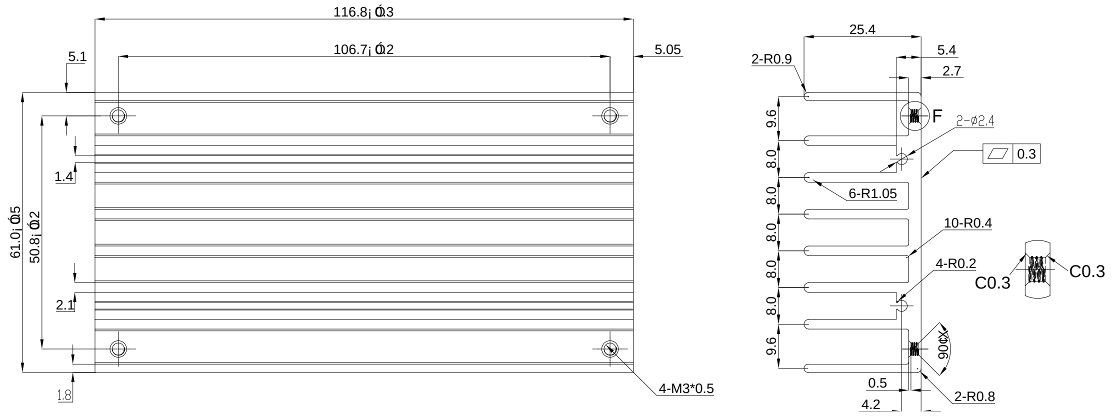


Heat Sink (Clear Mounting Inserts Φ3.3mm Through): 116.8*61*25.4(M-B012) (G6620090204)
Thermal PAD: SR60*115.8*0.23 (G6135013070)
Screw: M3*20L (G75A1300052)
Nut: NH+WOM3*P0.5N(G75A2440392)

Heat-sink M-C997

All Dimension In mm

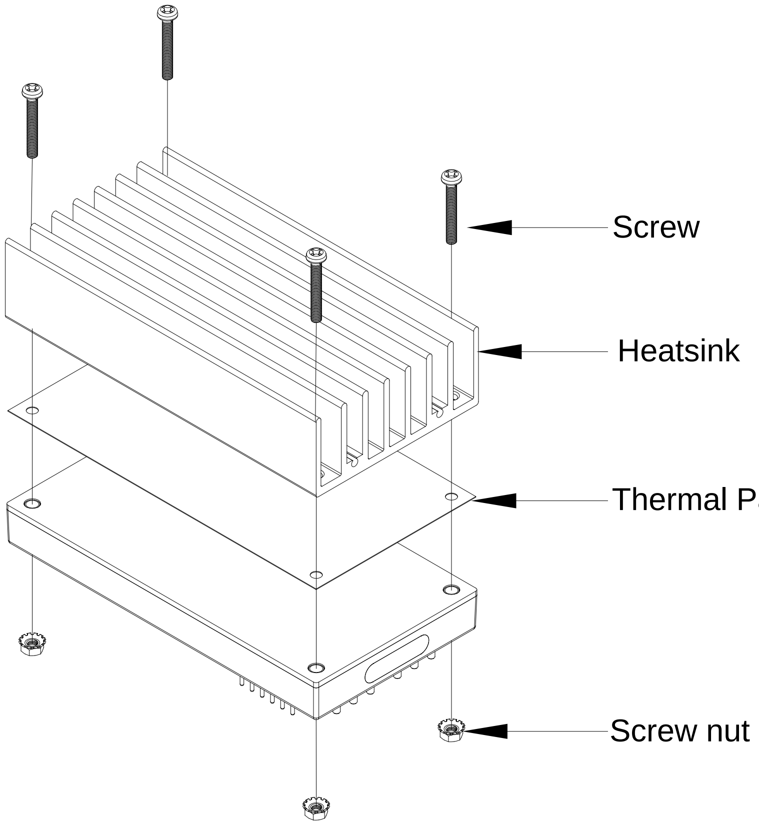
Longitudinal Fins



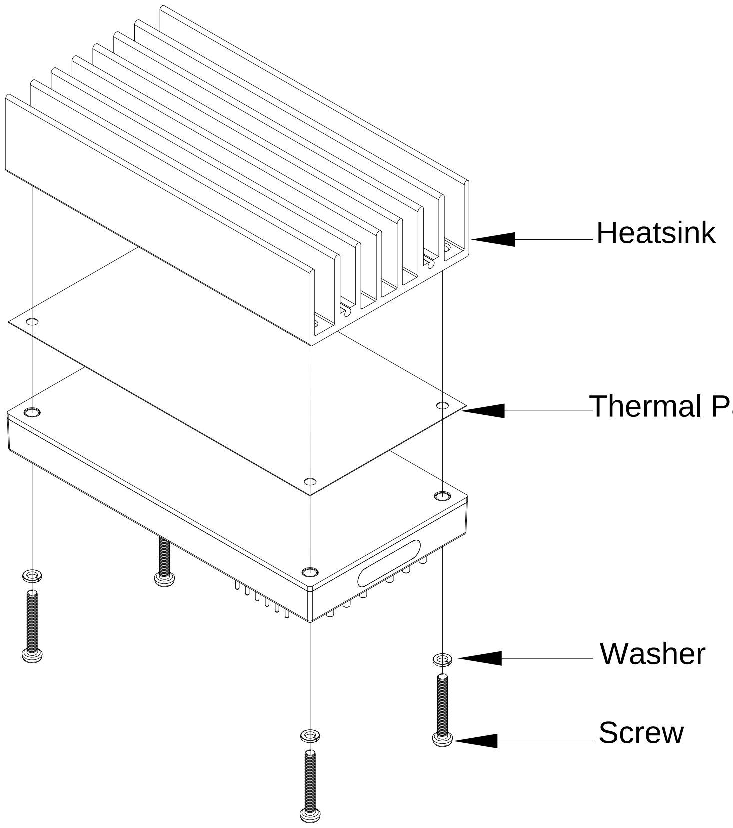
Heat Sink (Mounting Inserts M3*0.5 Through): 116.8*61*25.4(M-C997) (G6620980201)
Thermal PAD: SR60*115.8*0.23 (G6135013070)
Screw: M3*20L (G75A1300052)
Washer: WS3.2N (G75A47A0752)

AIR FLOW RATE	TYPICAL R_{ca}
Natural Convection 20ft./min. (0.1m/s)	2.4 °C/W
100 ft./min. (0.5m/s)	1.76 °C/W
200 ft./min. (1.0m/s)	1.17 °C/W
300 ft./min. (1.5m/s)	1.00 °C/W
400 ft./min. (2.0m/s)	0.83 °C/W

Full Brick Heat Sink Assembly

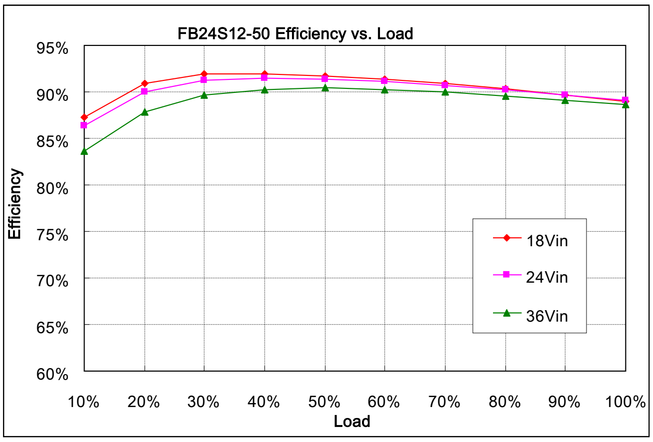


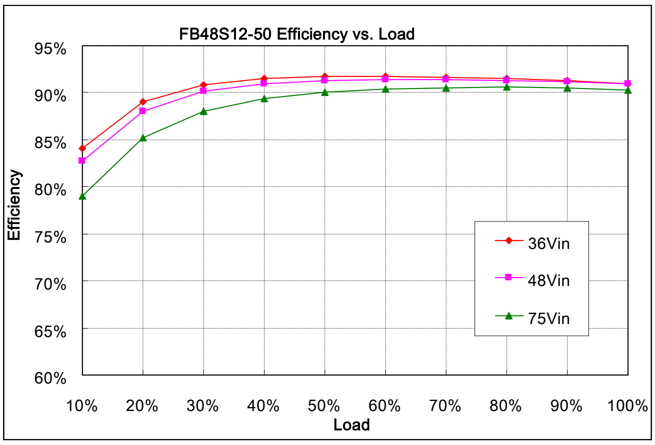
Heat Sink: M-B012
Thermal PAD: SR60*115.8*0.23 (G6135013070)
Screw: M3*20L (G75A1300052)
Nut: NH+WOM3*P0.5N(G75A2440392)

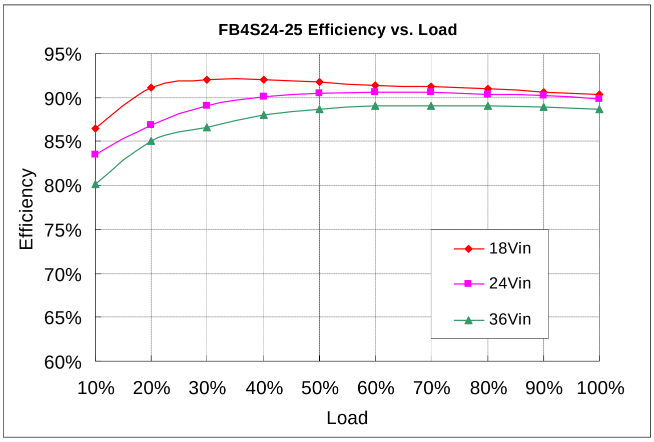


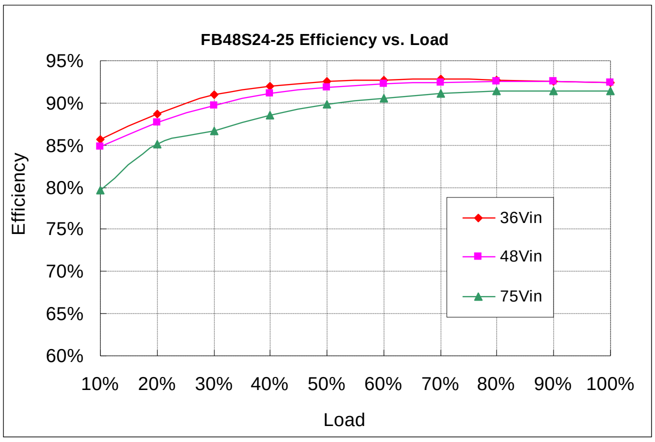
Heat Sink: M-C997
Thermal PAD: SR60*115.8*0.23 (G6135013070)
Screw: M3*20L (G75A1300052)
Washer: WS3.2N (G75A47A0752)

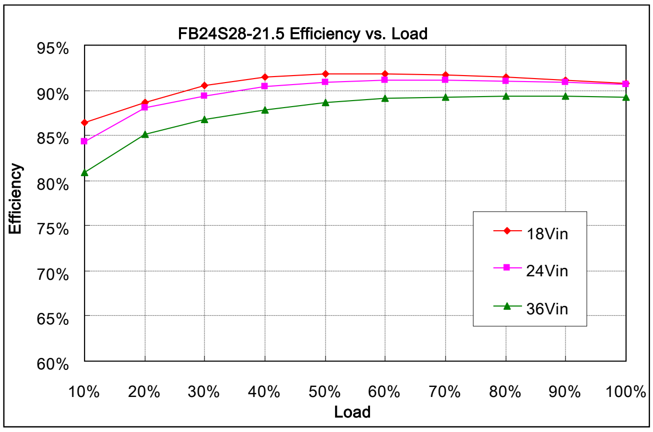
EFFICIENCY vs. LOAD

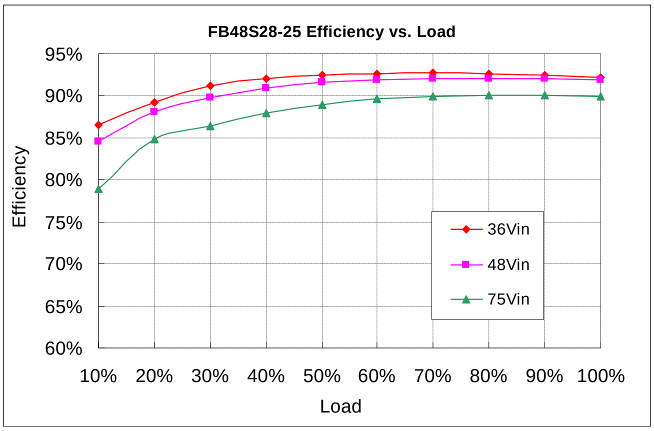


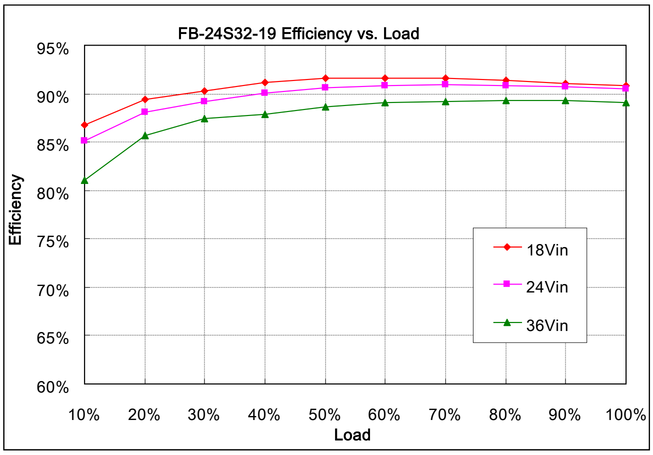


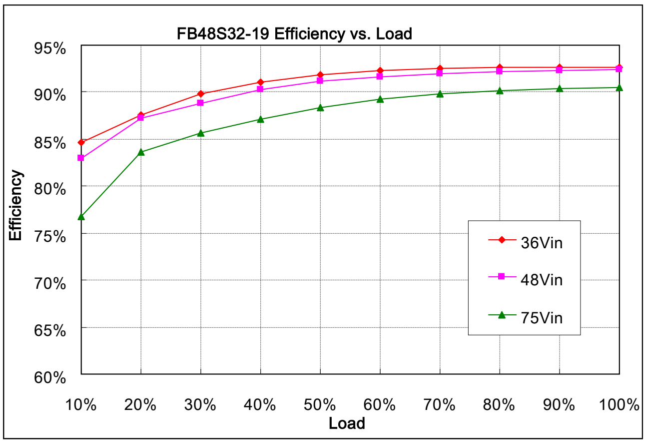


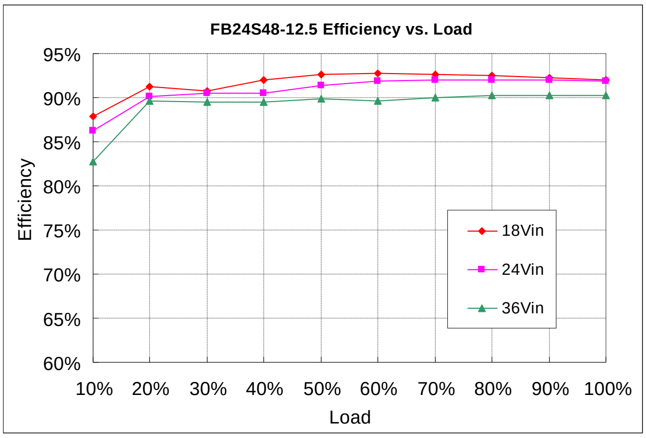


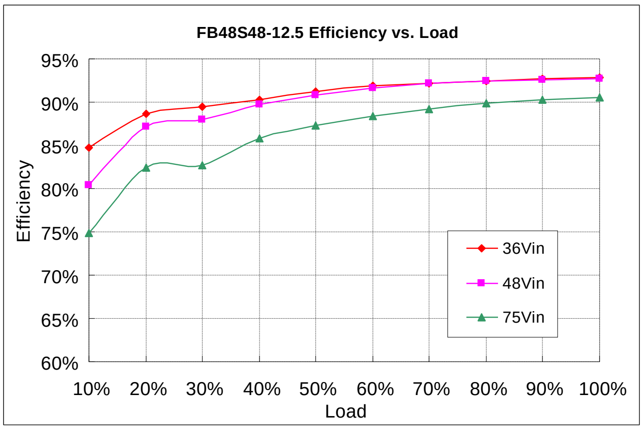









FB24S48-12.5 Efficiency vs. Load
95%
90%
85%
80%
75%
70%
65%
60%
Efficiency
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Load
18Vin
24Vin
36Vin


FB48S48-12.5 Efficiency vs. Load
95%
90%
85%
80%
75%
70%
65%
60%
Efficiency
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Load
36Vin
48Vin
75Vin

Test Set-Up

The basic test set-up to measure efficiency, load regulation, line regulation and other parameters is shown in the next figure. When testing the converter under any transient conditions, the user should ensure that the transient response of the source is sufficient to power the equipment under test. Below is the calculation of:

1- Efficiency
2- Load regulation
3- Line regulation

The value of efficiency is defined as:

$$\eta = \frac{Vo \times Io}{Vin \times Iin} \times 100\%$$

Where:

V_o is output voltage,
I_o is output current,
V_{in} is input voltage,
I_{in} is input current.

The value of load regulation is defined as:

$$Load.reg = \frac{V_{FL} - V_{NL}}{V_{NL}} \times 100\%$$

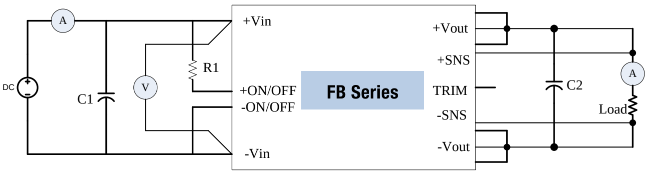
Where:

V_{FL} is the output voltage at full load
V_{NL} is the output voltage at no load

The value of line regulation is defined as:

$$Line.reg = \frac{V_{HL} - V_{LL}}{V_{LL}} \times 100\%$$

Where: V_{HL} is the output voltage of maximum input voltage at full load.
V_{LL} is the output voltage of minimum input voltage at full load.



FB Series Test Setup

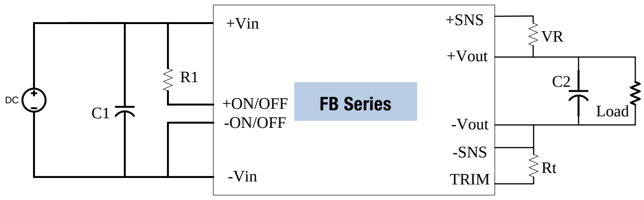
Recommend C1and C2 Value

C1:220uF/100V, C2:470uF/100V

For FB series it's necessary to connect the input electrolytic capacitor C1 with low ESR to prevent the effective of input line inductance to the DC/DC converter.
For stable operation, connect a low impedance electrolytic capacitor C2 in the output terminals. When operated at lower temperature than -20°C, increasing the C2 capacitance with three or four times more than the recommended value.

Output Voltage Adjustment

The Trim input permits the user to adjust the output voltage up or down according to the trim range specification (60% to 110% of nominal output). This is accomplished by connecting an external resistor between the +Vout and +Sense pin for trim up and between the TRIM and –Sense pin for trim down, see figure below:



Output voltage trim circuit configuration

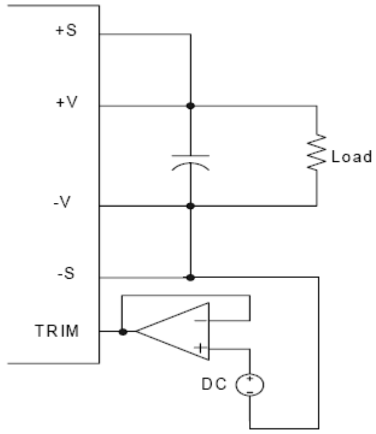
The Trim pin should be left open if trimming is not being used. The output voltage can be determined by the following equations:

$$Vf = \frac{1.24 \times (\frac{Rt \times 33}{Rt + 33})}{7.68 + \frac{Rt \times 33}{Rt + 33}}$$

$$Vout = (Vo + VR) \times Vf$$

Unit: KΩ
Vo: Nominal Output Voltage
Recommend Rt=6.8KΩ

The output voltage can also be adjustment by using external DC voltage



*Output Voltage = TRIM Terminal Voltage * Nominal Output Voltage*

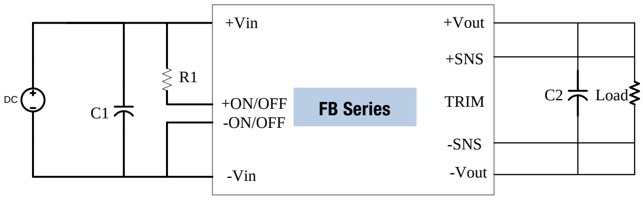
Output Remote Sensing

The FB series of converters has the capability to remotely sense both lines of its output. This feature moves the effective output voltage regulation point from the output of the unit to the point of connection of the remote sense pins. This feature automatically adjusts the real output voltage of the FB series in order to compensate for voltage drops in distribution and maintain a regulated voltage at the point of load. The remote-sense voltage range is:

$[(+V_{out}) - (-V_{out})] - [(+Sense) - (-Sense)] \leqq 10\%$ of $V_{o\_nominal}$

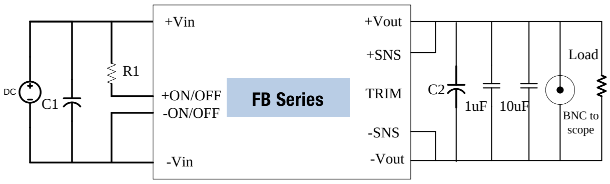
If the remote sense feature is not to be used, the sense pins should be connected locally. The +Sense pin should be connected to the +Vout pin at the module and the -Sense pin should be connected to the -Vout pin at the module.

This is shown in the schematic below.



Note: Although the output voltage can be increased by both the remote sense and by the trim, the maximum increase for the output voltage is not the sum of both. The maximum increase is the larger of either the remote sense or the trim. The amount of power delivered by the module is defined as the voltage at the output terminals multiplied by the output current. When using remote sense and trim, the output voltage of the module can be increased and consequently increase the power output of the module if output current remains unchanged. Care should be taken to ensure that the maximum output power of the module remains at or below the maximum rated power (Maximum rated power = $V_{o,set}$ x $I_{o,max}$)

Output Ripple and Noise



Output ripple and noise is measured with 1.0uF ceramic and 10uF solid tantalum capacitors across the output.

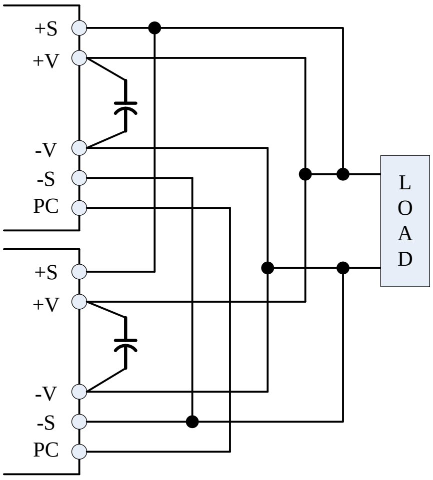
6.11 Output Capacitance

The FB series converters provide unconditional stability with or without external capacitors. For good transient response, low ESR output capacitors should be located close to the point of load. PCB design emphasizes low resistance and inductance tracks in consideration of high current applications. Output capacitors with their associated ESR values have an impact on loop stability and bandwidth. The minimum output capacitance is 470μF which need three or four times capacitance when operating below -20°C and the absolute maximum value of FB series' output capacitance is 10000μF. For values larger than this, please contact your local DATEL's representative.

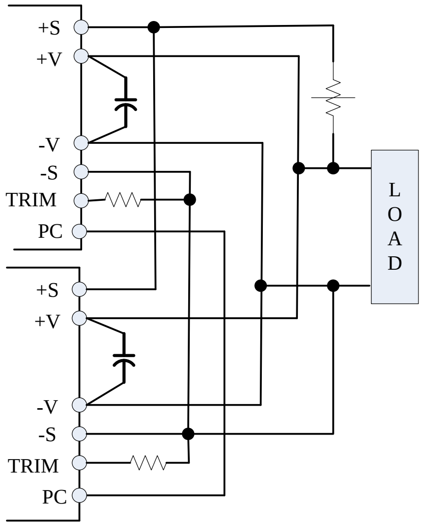
Parallel Operation

The FB series are also designed for parallel operation. When paralleled, the load current can be equally shared between the modules by connecting the PC pins together. There are two different parallel operations for FB series, one is parallel operation when load can't be supplied by only one power unit; the other is the N+1 redundant operation which is high reliable for load of N units by using N+1 units.

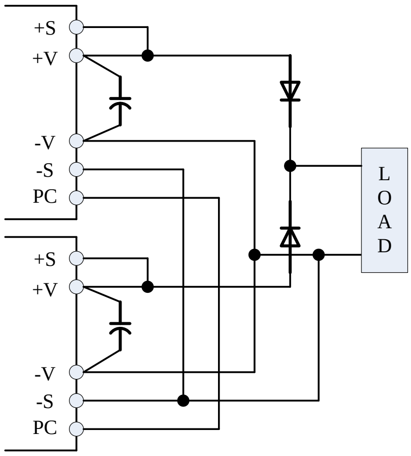
(a) parallel operation



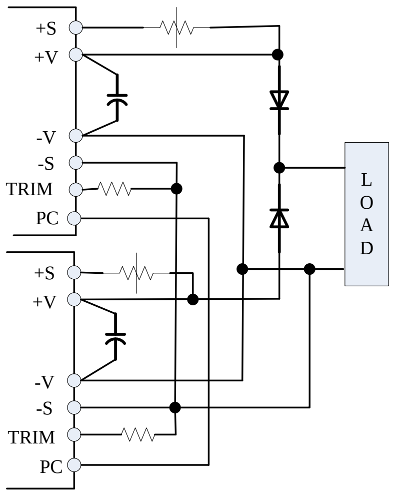
(b) Parallel operation with programmed and adjustable output



(c) N+1 redundant connection

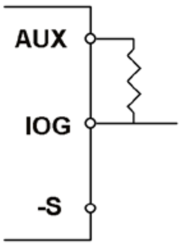


(d) N+1 redundant connection with programmed output and adjustable output voltage

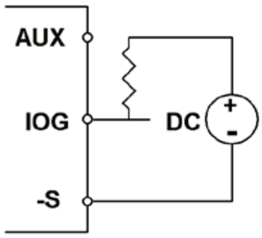


IOG signal

Normal and abnormal operation of the converter can be monitored by using the I.O.G signal. Output of this signal monitor is located at the secondary side and is an open collector, you can use the signal by the internal aux power supply or the external DC supply as the following figures. The ground reference is the –Sense Pin.



By internal AUX



By external DC supply

This signal is LOW when the converter is normally operating and HIGH when the converter is disabled or when the converter is abnormally operating.

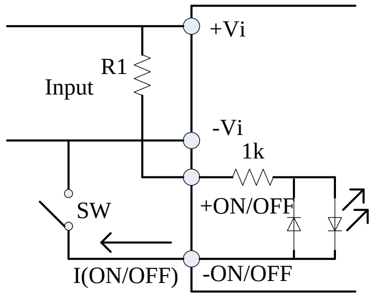
Auxiliary Power for output signal

The auxiliary power supply output is within 7-13V with maximum current of 20 mA. Ground reference is the –sense Pin.

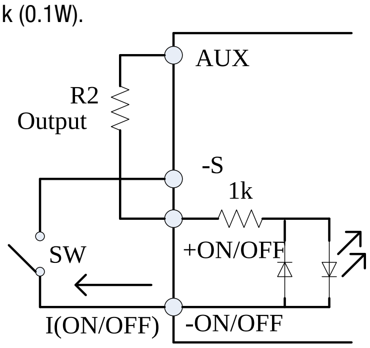
On/Off Control

The converter On/Off function can be controlled from the input side or the output side. Output voltage turns on when current is made to through On/Off terminals which can be reached by opening or closing the switches. The maximum current through the On/Off pin is 10mA, setting the resistor value to avoid the maximum current through the On/Off pins.

(A) Controlling the On/Off terminal from the input side, recommend R1 value is 30K (0.5W) for 48Vin and 15K (0.25W) for 24Vin.



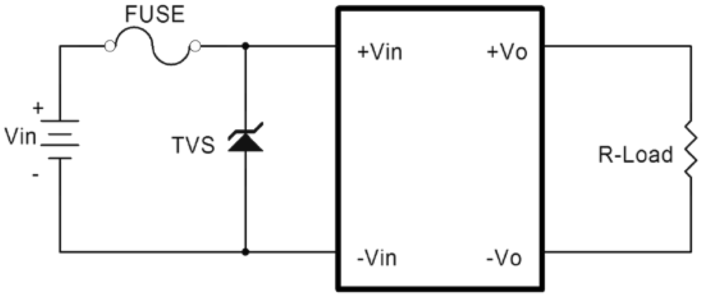
(B) Controlling the ON/OFF terminal from the output side, Recommend R2 value is 5.1k (0.1W).



SAFETY and EMC

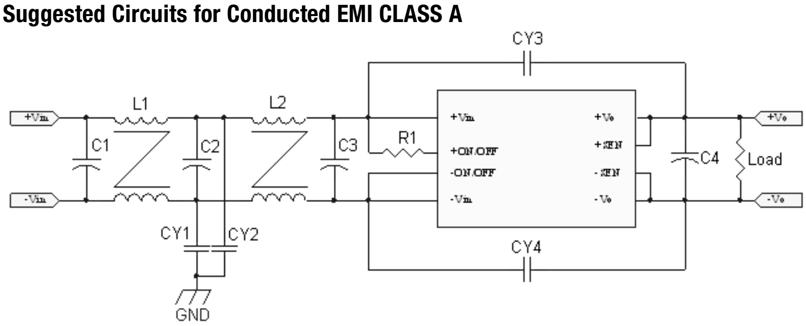
Input Fusing and Safety Considerations

The FB series converters have no internal fuse. In order to achieve maximum safety and system protection, always use an input line fuse. We recommended a 60A time delay fuse for 24V_{in} models, and 30A for 48V_{in} models. It is recommended that the circuit have a transient voltage suppressor diode (TVS) across the input terminal to protect the unit against surge or spike voltage and input reverse voltage (as shown).



EMC Considerations

Suggested Circuits for Conducted EMI CLASS A

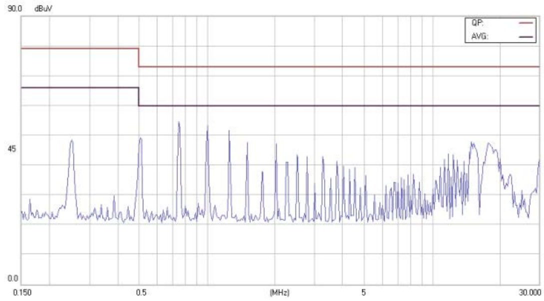


(1) EMI and conducted noise meet EN55022 Class A specifications:

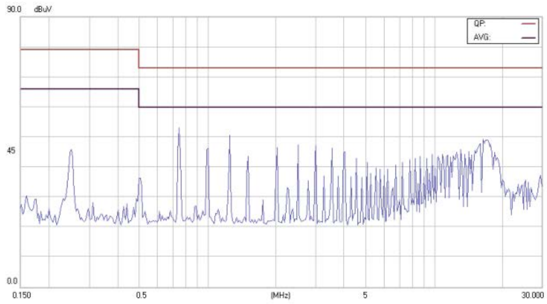
Model No.	C1	C2	C3	CY1/CY2	CY3/CY4	C4	L1	L2	R1
FB24S12-50	1000µF/50V	2.2µF/100V	1000uF/50V	0.1µF	NC	470µF/100V+10µF/50V	Short	1mH	15K
FB24S24-25	1000µF/50V	2.2µF/100V	1000µF/50V	0.1µF	NC	470µF/100V+10µF/50V	Short	1mH	15K
FB24S28-21.5	1000µF/50V	2.2µF/100V	1000µF/50V	0.1µF	NC	470µF/100V+10µF/50V	Short	1mH	15K
FB24S32-19	1000µF/50V	2.2µF/100V	1000µF/50V	0.1µF	NC	470µF/100V+10µF/50V	Short	1mH	15K
FB24S48-12.5	1000µF/50V	2.2µF/100V	1000µF/50V	0.1µF	NC	470µF/100V+10µF/50V	Short	1mH	15K
FB48S12-50	NC	470µF/100V	470µF/100V	10000pF	10000pF*2	470µF/100V	Short	2mH	30K
FB48S24-25	NC	470µF/100V	470µF/100V	10000pF	10000pF*2	470µF/100V	Short	2mH	30K
FB48S28-25	NC	470µF/100V	470µF/100V	10000pF	10000pF*2	470µF/100V	Short	2mH	30K
FB48S32-19	NC	470µF/100V	470µF/100V	10000pF	10000pF*2	470µF/100V	Short	2mH	30K
FB48S48-12.5	NC	470µF/100V	470µF/100V	10000pF	10000pF*2	470µF/100V	Short	2mH	30K

Note: 1000µF/50V is NIPPON CHEMI-CON KY series aluminum capacitors, 470µF/100V is Nichicon PS(M) series aluminum capacitors,CY1, CY2, CY3 & CY4 is Y1 capacitors, other capacitors is ceramic capacitors 2220 size. Inductor core material is VAC W523, 1mH is 1.2mm*2 6T, 2mH is 1.5mm*1 8T.

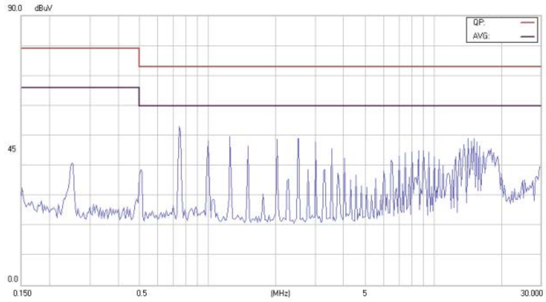
I



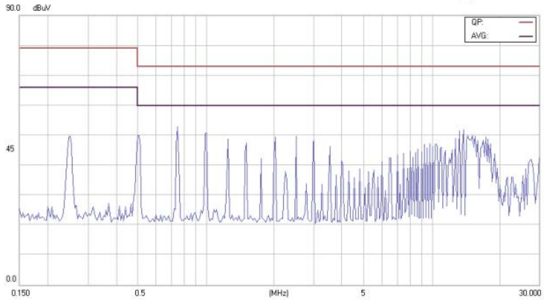
Class A test conducted for FB24S12-50



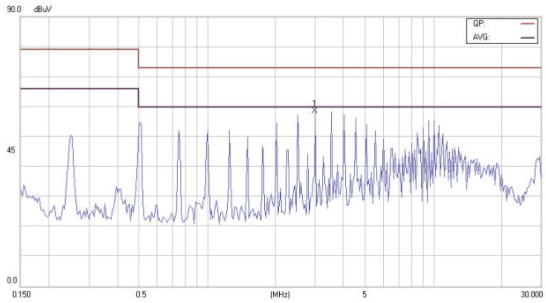
Class A test conducted for FB24S24-25



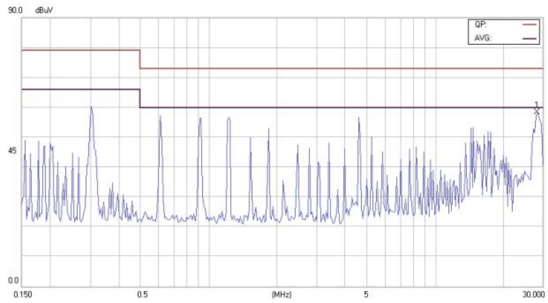
Class A test conducted for FB24S28-21.5



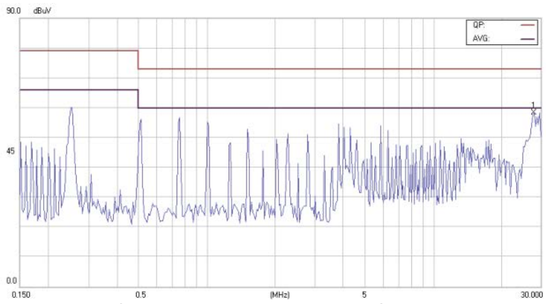
Class A test conducted for FB24S32-19



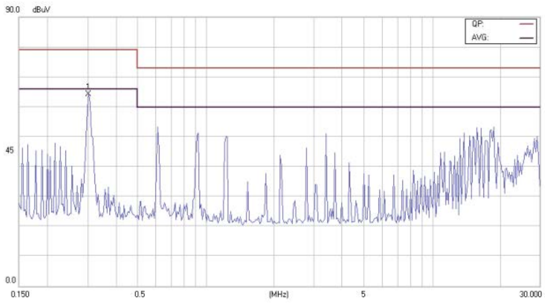
Class A test conducted for FB24S48-12.5



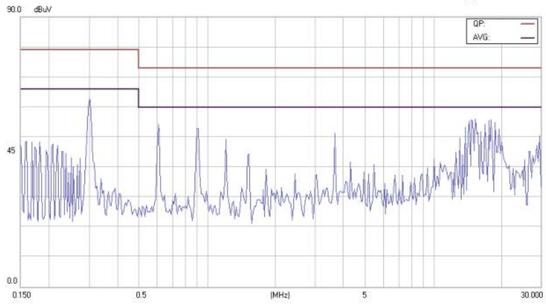
Class A test conducted for FB48S12-50



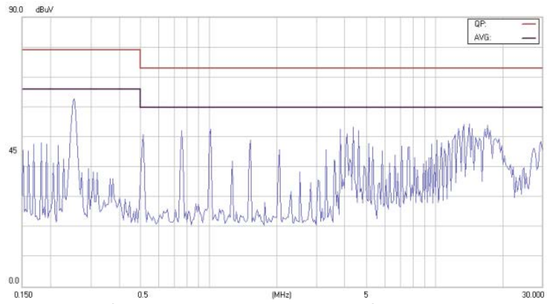
Class A test conducted for FB48S24-25



Class A test conducted for FB48S28-25

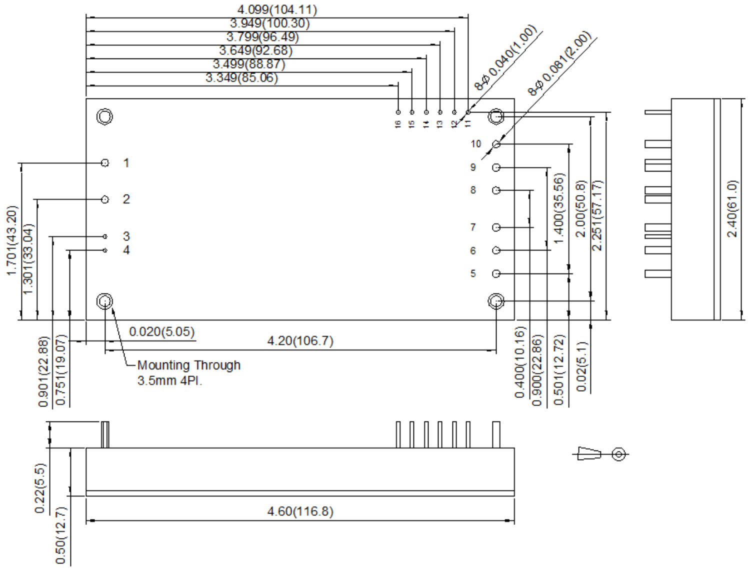


Class A test conducted for FB48S32-19



Class A test conducted for FB48S48-12.5

MECHANICAL SPECIFICATIONS



Note: All dimensions are in inches (millimeters). Tolerance: x.xx ±0.02 in. (0.5mm), x.xxx ±0.010 in. (0.25 mm) unless otherwise noted

PIN CONNECTIONS

PIN CONNECTION			
PIN	**SINGLE**	**PIN**	**SINGLE**
1	+ V Input	11	+ Sense
2	+ V Input	12	- Sense
3	-ON/OFF	13	Trim
4	+ON/OFF	14	PC/NC
5, 6, 7	+ V Output	15	I.O.G
8, 9, 10	- V Output	16	Auxiliary

PART NUMBER ORDERING INFORMATION

Family, Form Factor Package	Nominal Input Voltage	Number of Outputs	Voltage Output		Current Output (A)	Options
FB	**24**	**S**	**12**	**–**	**6**	**N, P, H**

- Nominal Input Voltage: (18-36) 24 Volts; (36-75) 48 Volts
- Number of Outputs: S- Single
- Voltage Output: 12 Volts, 24Volts, 28 Volts, 32 Volts, 48 Volts
- Current Output (A): 12 Volts - 50A, 24 Volts - 25A, 28 Volts – 21.5A, 32Volts – 19A, 48 Volts – 12.5A
- Options: None - Negative On/Off control; P - Positive On/Off control; H - Heatsink

Note: For proper part ordering, enter option suffixes in the order listed in the table above